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(54) **DEVICE, SYSTEM AND METHOD FOR TRANSFERRING NETWORK DATA**

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(52) **U.S. Cl.**  
CPC ..... **G06T 1/20** (2013.01)

(58) **Field of Classification Search**  
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See application file for complete search history.

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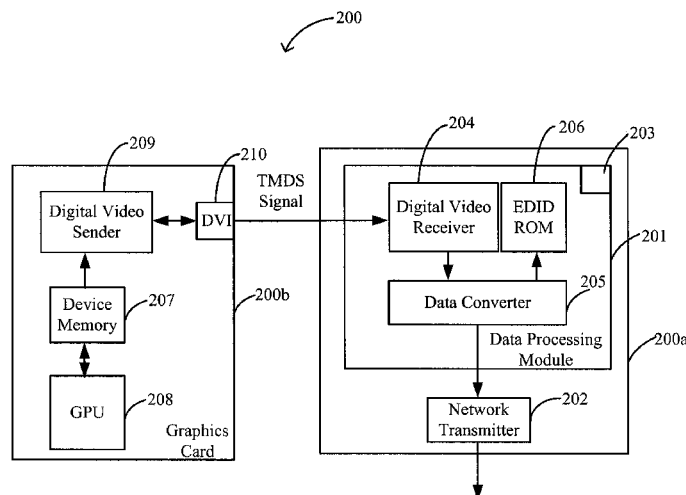
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(57) **ABSTRACT**

A device, system and method for transferring network data are presented. The device includes: a data processing module configured to convert a data signal in a TMDS signal output via a DVI of a graphics card to network data for being transferred via a network; and a network transmitter for receiving the network data and transferring the network data to an external device via the network. The data signal is generated by encoding texture data generated by a GPU of the graphics card by a digital video sender of the graphics card. The texture data is generated by binding a pointer to general computing data stored in a device memory of the graphics card to a texture stored in the device memory by the GPU. The general computing data is generated by general computation executed by the GPU.

**25 Claims, 3 Drawing Sheets**



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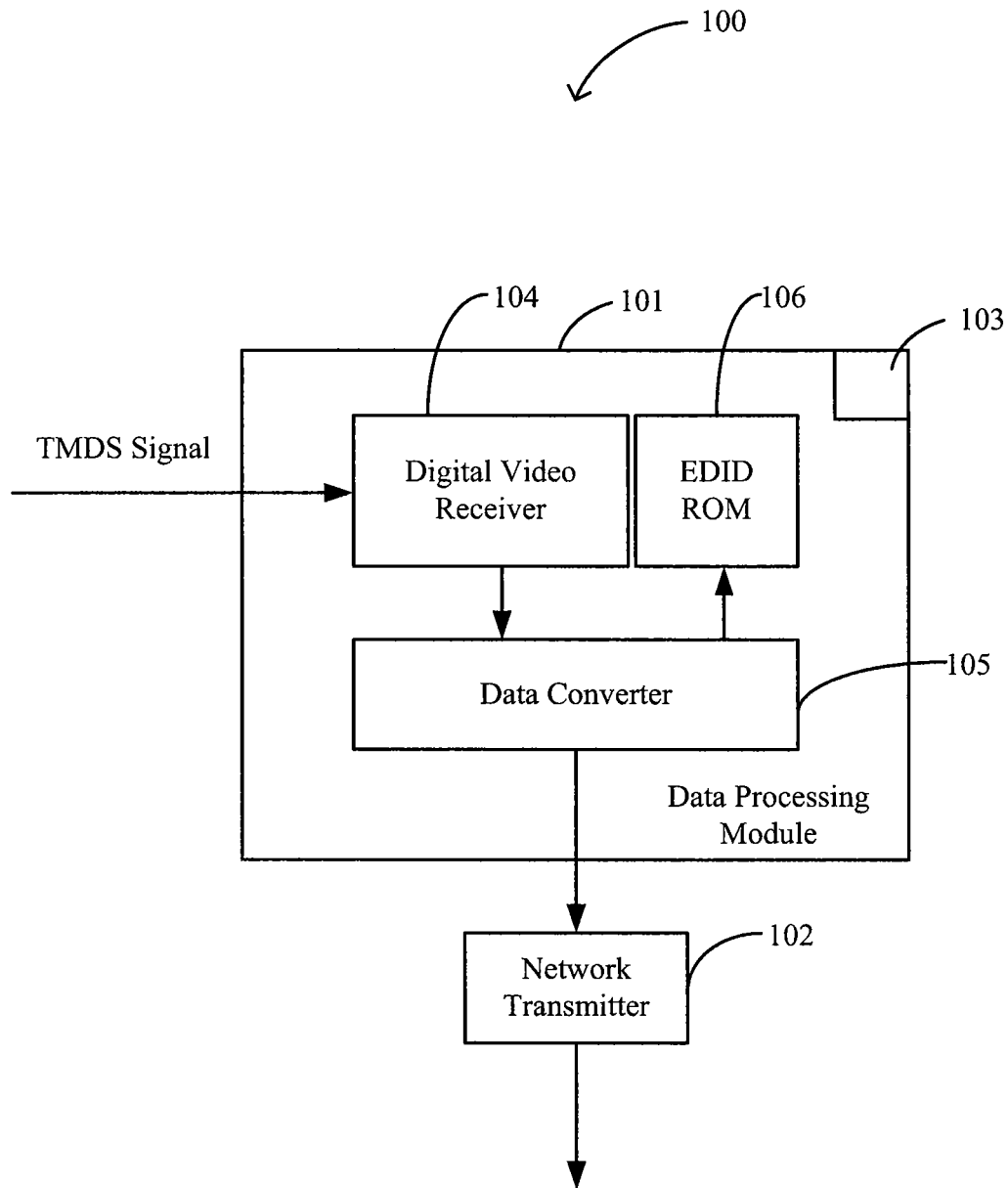


Fig. 1

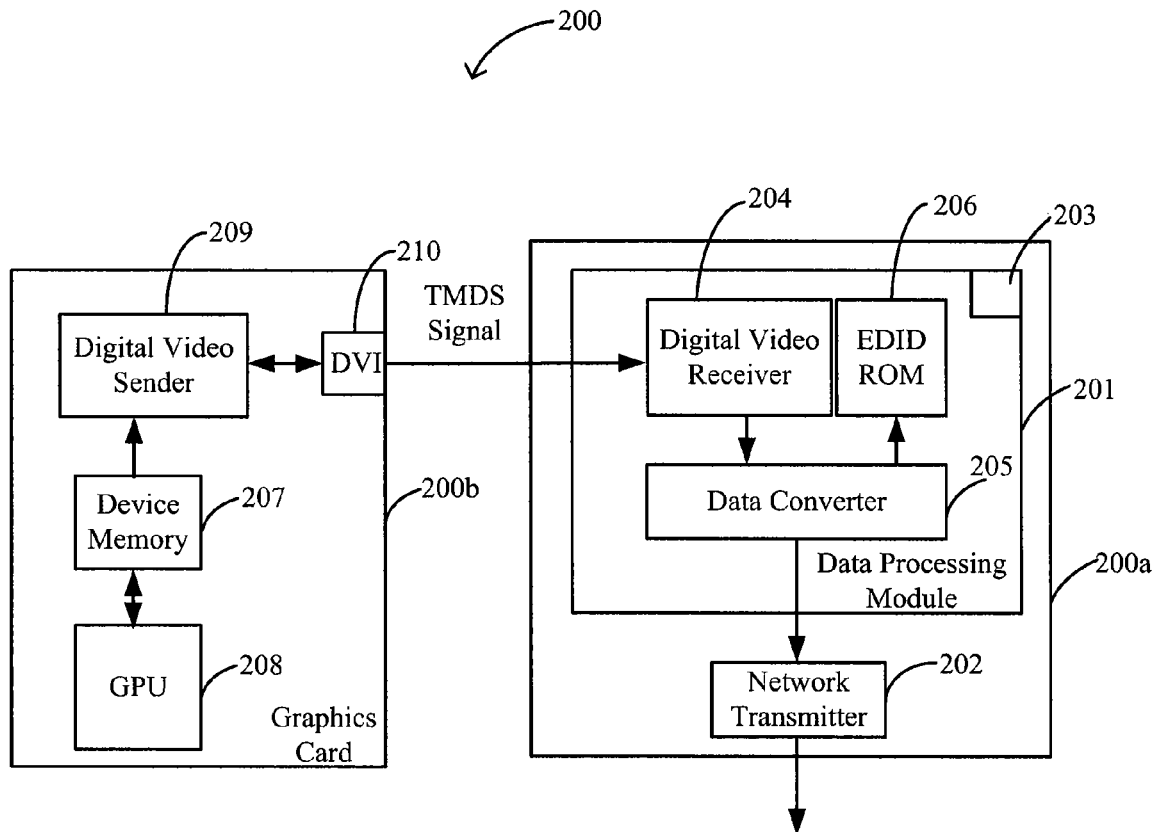


Fig. 2

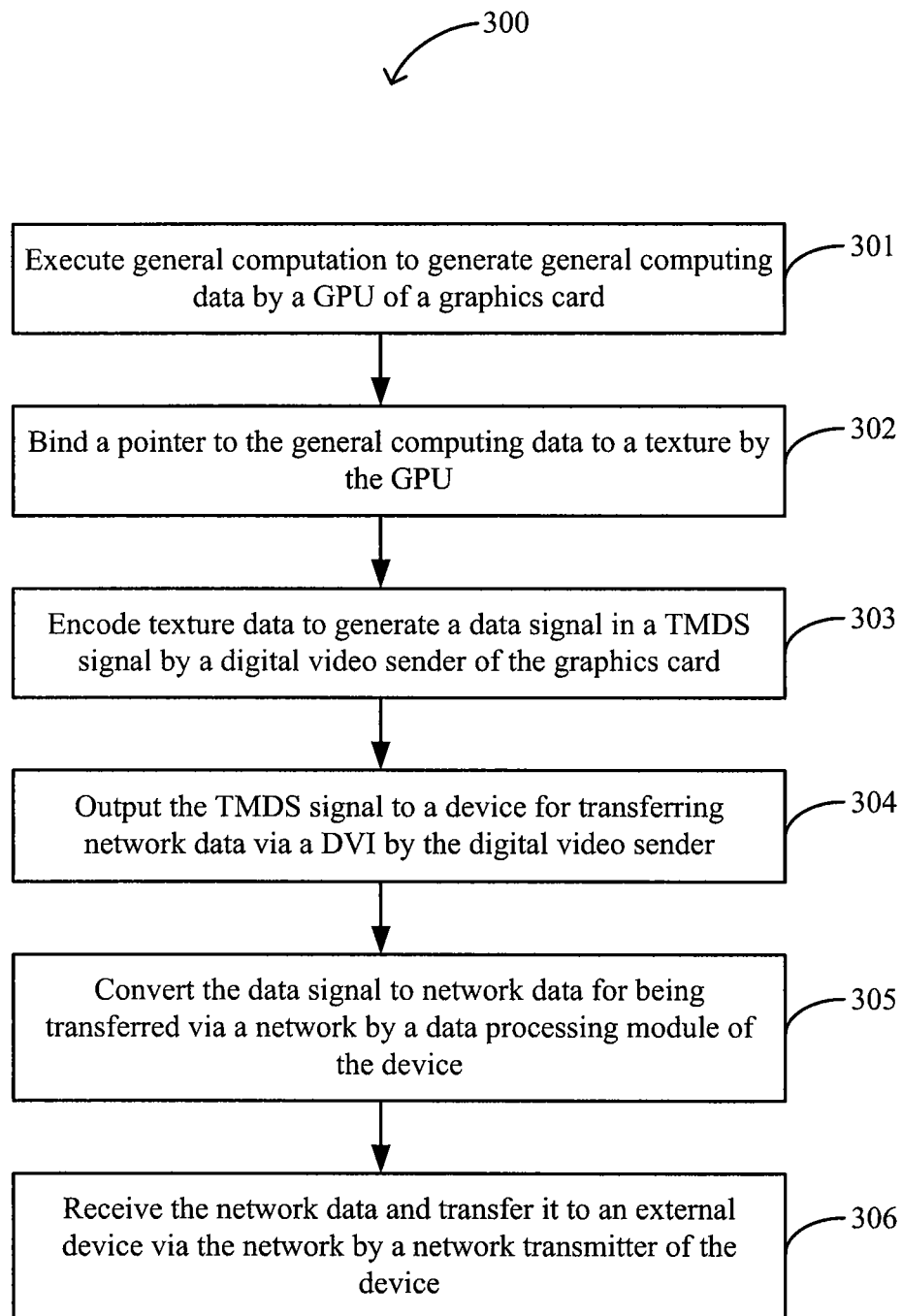


Fig. 3

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**DEVICE, SYSTEM AND METHOD FOR  
TRANSFERRING NETWORK DATA****CROSS-REFERENCE TO RELATED  
APPLICATIONS**

This application claims priority to Chinese Patent Application No. 201310049967.4, filed on Feb. 7, 2013, which is hereby incorporated by reference.

**BACKGROUND OF THE INVENTION****Field of Invention**

The present invention relates generally to the field of communication, and more particularly to a device, system and method for transferring network data.

Graphics card, which is one of the most basic components of a personal computer, takes on the task of outputting graphics for being displayed. Graphics processing unit (GPU), the core of a graphics card, substantially decides performance of the graphics card. Initially, GPU is mainly used for rendering graphics, however, with the development of programmable ability and performance of GPU, it is no longer limited to graphics processing but begins to enter the field of high-performance computing (HPC).

When GPU is used for general computation, it is usually needed that data processed by the GPU is transferred to a remote external device via a network for being further processed. A current method for transferring such network data includes the following steps. Initially, original data is computed by the GPU and then the computed result data is stored in a video memory. Central Processing Unit (CPU) copies the computed result data in the video memory to an internal memory of a computer system. The CPU transfers the computed result data to a remote external device via a network based on a communications protocol. During the above transferring process, memory resources and CPU resources of the computer system may be wasted and the delay in the transferring process may be increased. In addition, a PCIE bus is needed for the transferring and the bandwidth of the PCIE bus is limited. Thus, the demands of device with larger bandwidth for some applications, such as video stream processing application, digital modulation, software radio, radar system, computed tomography and ultrasonic imaging, etc., cannot be satisfied. Meantime, because the delay of the PCIE bus is not fixed, the input and the output of data in the video memory cannot be synchronized, affecting directly the speed of processing general computing data of the GPU.

**SUMMARY OF THE INVENTION**

Accordingly, there is a need in the art for technology capable of decreasing the delay in the transferring process of network data and saving computer system resources.

In one embodiment, a device for transferring network data is disclosed. The device includes a data processing module configured to convert a data signal in a TMDS (transition minimized differential signaling) signal output via a digital video interface (DVI) of a graphics card to network data for being transferred via a network. The device also includes a network transmitter for receiving the network data and transferring the network data to an external device via the network. The data signal is generated by encoding texture data generated by a GPU of the graphics card by a digital video sender of the graphics card. The texture data is

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generated by binding a pointer to general computing data stored in a device memory of the graphics card to a texture stored in the device memory by the GPU. The general computing data is generated by general computation executed by the GPU.

Preferably, a network data transfer operation of the device is controlled by a control signal in the TMDS signal.

Preferably, the device is powered at least partially by a power signal in the TMDS signal.

Preferably, the device further includes a power interface, via which an external power source provides additional electric energy to the device.

Preferably, the data processing module includes a digital video receiver configured to decode the data signal to parallel data and a data converter configured to convert the parallel data to the network data according to a communications protocol.

Preferably, the network transmitter is a wired network transmitter for transferring the network data to the external device via a wired connection.

Preferably, the network transmitter is a wireless network transmitter for transferring the network data to the external device wirelessly.

Preferably, the network transmitter includes a wired network transmitter and a wireless network transmitter, and the data processing module is further configured to control the network data to be transferred to the external device via the wired network transmitter or the wireless network transmitter.

Preferably, the data processing module includes an encryption module configured to encrypt the network data before the network data is received by the network transmitter.

Preferably, the data processing module includes an extended display identification data memory (EDID ROM) for storing virtual display information, so that the graphics card reads the virtual display information via the DVI and determines a transfer parameter of the TMDS signal according to the virtual display information.

In another embodiment, a system for transferring network data is presented. The system includes one or more subsystems for transferring network data, each of which includes a graphics card and a device for transferring network data. The graphics card includes a device memory for storing general computing data and a texture. The graphics card also includes a GPU configured to execute general computation to generate the general computing data and bind a pointer to the general computing data to the texture to generate texture data. The graphics card also includes a digital video sender for encoding the texture data to generate a data signal in a TMDS signal and outputting the TMDS signal to the device via a DVI of the graphics card. The device includes a data processing module configured to convert the data signal to network data for being transferred via a network. The device also includes a network transmitter for receiving the network data and transferring the network data to an external device via the network.

Preferably, the TMDS signal includes a control signal to control a network data transfer operation of the device.

Preferably, the TMDS signal includes a power signal, which is transferred to the device via the DVI for powering the device at least partially.

Preferably, the device further includes a power interface, via which an external power source provides additional electric energy to the device.

Preferably, the data processing module includes a digital video receiver configured to decode the data signal to

parallel data and a data converter configured to convert the parallel data to the network data according to a communications protocol.

Preferably, the network transmitter is a wired network transmitter for transferring the network data to the external device via a wired connection.

Preferably, the network transmitter is a wireless network transmitter for transferring the network data to the external device wirelessly.

Preferably, the network transmitter includes a wired network transmitter and a wireless network transmitter, and the data processing module is further configured to control the network data to be transferred to the external device via the wired network transmitter or the wireless network transmitter.

Preferably, the data signal includes a vertical synchronizing (VSYNC) signal to control processing speed of the GPU.

Finally, in a different embodiment, a method for transferring network data is disclosed. The method includes: executing general computation to generate general computing data and binding a pointer to the general computing data to a texture to generate texture data by a GPU of a graphics card, wherein the general computing data and the texture are stored in a device memory of the graphics card; encoding the texture data to generate a data signal in a TMDS signal and outputting the TMDS signal to a device for transferring network data via a DVI of the graphics card by a digital video sender of the graphics card; converting the data signal to network data for being transferred via a network by a data processing module of the device; and receiving the network data and transferring the network data to an external device via the network by a network transmitter of the device.

The technology provided by the present invention can decrease the delay during transferring general computing data of a GPU to an external device via a network, save computer system resources and satisfy the demands of an external device with large bandwidth.

Advantages and features of the present invention will be described in detail below in connection with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

In order that the advantages of the invention will be readily understood, a more detailed description of the invention briefly described above will be rendered by reference to specific embodiments that are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings.

FIG. 1 illustrates a schematic block diagram of a device for transferring network data, according to an embodiment of the present invention;

FIG. 2 illustrates a schematic block diagram of a subsystem for transferring network data, according to an embodiment of the present invention; and

FIG. 3 illustrates a flow chart of a method for transferring network data, according to an embodiment of the present invention.

#### DETAILED DESCRIPTION

In the following discussion, details are presented so as to provide a more thorough understanding of the present invention. However, the present invention may be implemented

without one or more of these details as would be apparent to one of ordinary skill in the art. Certain examples are illustrated without elaborate discussion of technical features that would be within the purview of one of ordinary skill in the art so as to avoid confusion with the present invention.

The present invention discloses a device for transferring network data. FIG. 1 illustrates a schematic block diagram of a device **100** for transferring network data, according to an embodiment of the present invention. The device **100** includes a data processing module **101** and a network transmitter **102**. The data processing module **101** is configured to convert a data signal in a TMDS signal output via a DVI of a graphics card to network data for being transferred via a network. For example, parallel data is packaged into frames, i.e. network data, according to TCP/IP. Then the data processing module **101** transfers the network data to the network transmitter **102**. The network transmitter **102** is used for receiving the network data and transferring the network data to an external device via the network. The above data signal in the TMDS signal is obtained from general computing data generated by general computation executed by a GPU of the graphics card. Texture data is generated by binding a pointer to the general computing data stored in a device memory of the graphics card to a texture stored in the device memory by the GPU of the graphics card. Then the data signal is generated by encoding the texture data generated by the GPU of the graphics card by a digital video sender of the graphics card. More specifically, the GPU executes the general computation on original data to be processed to obtain the general computing data and stores the general computing data in the device memory of the graphics card, i.e. video memory. Then the GPU creates a texture through Application Program Interface (API), e.g. OpenGL, in the device memory. "Texture" is a bitmap which stores surface material color, and the image rendered by the texture can be displayed on a display apparatus. What is usually bound to a texture is image data in prior art. According to an embodiment of the present invention, the image data is replaced with the general computing data and the general computing data is bound to the texture. Specifically, the GPU binds a pointer to the general computing data to the texture to generate the texture data. That is, the texture data refers to the bound general computing data. Then the digital video sender of the graphics card encodes the texture data into a TMDS signal and outputs the TMDS signal to the data processing module **101** via the DVI. In a preferable embodiment, the data processing module **101** and the network transmitter **102** are integrated into a module, which is beneficial for unified design and industrialization of the module.

The data signal output from the graphics card may be transformed by the data processing module **101** and the network transmitter **102** to be transferred to an external device via the network finally. The external device may be, for example, Internet Protocol Television (IPTV), compute nodes, Personal Computer (PC), Phone or Mobile Internet Device (MID), etc. The external device may support security/throughout management and support web server/broadcast. Transferring a data signal of a graphics card by the device **100** may save computer system resources, obtain low latency and high speed, and may satisfy the demands for transferring a large amount of data.

Alternatively, a network data transfer operation of the device **100** may be controlled by a control signal in the TMDS signal. The TMDS signal output via the DVI of the graphics card may contain a control signal, which may control the data processing module **101** and the network

transmitter **102** to execute corresponding operations. In an embodiment, the control signal may control the data processing module **101** and the network transmitter **102** to transfer the network data to a particular external device. The control signal may contain address information of a target device. The data processing module **101** may convert the address information to a hardware address of the target device, and then indicate the network transmitter **102** to transfer the network data to the target device according to the hardware address. In a word, the control signal may enable the device **100** to transfer the network data as needed.

Alternatively, the device **100** may be powered at least partially by a power signal in the TMDS signal. In an embodiment, the DVI may include power pins and the TMDS signal may contain a power signal that is output to the device **100** via the power pins. The power signal may power the data processing module **101** and the network transmitter **102**. In an embodiment, the voltage value of the power signal may be 5V. The device **100** may be powered conveniently and efficiently by using the power signal output by the graphics card.

Alternatively, the device **100** may further include a power interface **103**, via which an external power source provides additional electric energy to the device **100**. Alternatively, the external power source may be a separate power source or a power source being used by the graphics card. Additional electric energy may be provided to the device **100** by using the external power source in order to avoid that the device **100** cannot operate properly when electric energy provided by the graphics card is insufficient.

Alternatively, the data processing module **101** may include a digital video receiver **104** and a data converter **105**. The digital video receiver **104** is configured to decode the data signal in the TMDS signal from the graphics card to parallel data. The data converter **105** is configured to convert the parallel data to the network data according to a communications protocol. The communications protocol may be any communications protocol known in the art, e.g. TCP/IP, NetBEUI, WAPI, etc. Preferably, the communications protocol is TCP/IP, which has a wide range of application, short response time for transferring data, less protocol interaction and is suitable for high-speed transfer. The digital video receiver **104** may include one or more decoders that may decode the data signal in the TMDS signal from the graphics card. The data converter **105** may control and manage the data transfer operation of the network transmitter **102**. For example, the data converter **105** may control the network transmitter **102** to transfer data to a particular target device. Alternatively, the digital video receiver **104** and the data converter **105** may be integrated into a module or be provided independently and respectively. Space and resources may be saved by integrating the digital video receiver **104** and the data converter **105** into a module. Detection and replacement of the module may benefit from providing the digital video receiver **104** and the data converter **105** independently and respectively. The data converter **105** may be implemented as any programmable device known in the art, for example, Application Specific Integrated Circuit (ASIC), Field Programmable Gate Array (FPGA), Complex Programmable Logic Device (CPLD), etc. Preferably, the data converter **105** is implemented as FPGA, which has low power consumption and flexible usage and may be used repeatedly. When the digital video receiver **104** and the data converter **105** are integrated into a module, the module may be implemented as any programmable device known in the art, for example, ASIC, FPGA, CPLD, etc., and preferably FPGA.

Alternatively, the data processing module **101** may also include an encryption module (not shown) configured to encrypt the network data before the network data is received by the network transmitter **102**. The encryption module may be programmed to encrypt the network data with a particular encryption algorithm to avoid the network data from being illegal intercepted and stolen when it is being transferred via the network, thus the security of useful information or private information contained in the network data may be guaranteed.

Alternatively, the data processing module **101** may also include an EDID ROM **106** for storing virtual display information, so that the graphics card reads the virtual display information via the DVI and determines a transfer parameter of the TMDS signal according to the virtual display information. In an embodiment, the virtual display information may include resolution and refresh rate. The GPU of the graphics card may access the EDID ROM **106** through a display data channel (DDC) in the DVI to read the resolution and the refresh rate stored in the EDID ROM **106**. The GPU regards the device **100** as a “display apparatus” after reading the resolution and the refresh rate. Then the graphics card may output data to the device **100**. In addition, the GPU may determine a transfer parameter of the TMDS signal according to the resolution and the refresh rate. The transfer parameter may include “frame size” and “transmission speed” of the TMDS signal. The GPU may control the frame size and the transmission speed of the TMDS signal to match them with the resolution and the refresh rate. In an embodiment, the virtual display information stored in the EDID ROM **106** may be rewritten by the data converter **105**, so the “frame size” and the “transmission speed” of the TMDS signal may be modified conveniently. In an embodiment, the EDID ROM **106** may be integrated in the data converter **105**, which is beneficial for saving space and cost.

Alternatively, the network transmitter **102** may be a wired network transmitter for transferring the network data to the external device via a wired connection. In an embodiment, the network transmitter **102** may encode the network data and convert the encoded network data to an analog signal for being transferred to the external device via a wired medium. The encoding mode of the network transmitter **102** may be, for example, Manchester encoding. The wired medium may employ any wired network transfer medium, for example twisted pair, optical fiber and coaxial cable, etc. The network transmitter **102** may also include a network interface for transferring the network data to the wired medium. The network interface may be, for example, RJ-45 interface, BNC interface, AUI interface, FDDI interface, etc. The wired network transmitter may make the transfer of the network data be more reliable and more stable.

Alternatively, the network transmitter **102** may be a wireless network transmitter for transferring the network data to the external device wirelessly. In an embodiment, the network transmitter **102** may encode the network data, convert the encoded network data to a radio signal and transmit the radio signal to the external device. The wireless network transmitter may make the system including the device **100** have good extensibility and be easy to maintain.

Alternatively, the network transmitter **102** may include a wired network transmitter and a wireless network transmitter. The data processing module **101** may be further configured to control the network data to be transferred to the external device via the wired network transmitter or the wireless network transmitter. In an embodiment, the data processing module **101** may be programmed to select a transfer mode and a transfer path of the network data. Thus



the device **100** may be used in different network environments conveniently and has a wide range of application.

Persons of ordinary skill in the art can understand that the above device **100** for transferring network data may be constructed to be an approximate cuboid. It may be provided with a DVI, for example, single-link DVI, dual-link DVI, two dual-link DVI and so on. Preferably, the device **100** is also provided with an antenna for transferring via a wireless network.

According to another aspect of the present invention, a system for transferring network data is also disclosed. The system includes one or more subsystems for transferring network data. FIG. 2 illustrates a schematic block diagram of a subsystem **200** for transferring network data, according to an embodiment of the present invention. As shown, the subsystem **200** includes a graphics card **200b** and a device **200a** for transferring network data. The graphics card **200b** includes a device memory **207**, a GPU **208**, a digital video sender **209** and a DVI **210**. The device memory **207** is used for storing general computing data and a texture. The GPU **208** is configured to execute general computation to generate the general computing data and bind a pointer to the general computing data to the texture to generate texture data. The digital video sender **209** is used for encoding the texture data to generate a data signal in a TMDS signal and outputting the TMDS signal to the device **200a** via the DVI **210**. The device **200a** includes a data processing module **201** and a network transmitter **202**. The data processing module **201** is configured to convert the data signal to network data for being transferred via a network. The network transmitter **202** is used for receiving the network data and transferring the network data to an external device via the network. In an embodiment, the system for transferring network data includes a plurality of subsystems **200**. Different subsystems may transfer general computing data processed by their respective GPUs **200b** to the same external device through their respective devices **200a**. The general computing data from different subsystems may be further processed, e.g. analyzed, gathered, etc., by the external device, thereby realizing distributed computation. Therefore, the above system has very powerful data processing ability and computing ability.

Alternatively, the TMDS signal may also include a control signal to control a network data transfer operation of the device **202a**.

Alternatively, the TMDS signal may also include a power signal, which is transferred to the device **202a** via the DVI **210** for powering the device **202a** at least partially.

Alternatively, the data signal in the TMDS signal may also include a VSYNC signal to control processing speed of the GPU **208**. In an embodiment, during one VSYNC period, the GPU **208** processes one frame of data and output it via the DVI **210**. Then the GPU **208** begins to process the next frame of data. Because the processing speed of the GPU **208** is far faster than the data output speed of the DVI **210**, it is may be avoided by using the VSYNC signal that the processing speed of the GPU **208** and the data output speed of the DVI **210** are nonsynchronous. Thereby data loss may be avoided.

Alternatively, the DVI **210** may be single-link DVI, dual-link DVI or two dual-link DVI, etc. Using multi-link DVI may better satisfy the demands for transferring a large amount of data. The DVI may be, for example, DVI-A, DVI-I and DVI-D, etc.

The data processing module and the network transmitter involved in the above system for transferring network data have been described in the description about embodiments

of the device for transferring network data. For brevity, a detailed description thereof is omitted. Those skilled in the art can understand that specific structure and operation mode thereof with reference to FIG. 1 and FIG. 2 in combination with the above description.

According to yet another aspect of the present invention, a method for transferring network data is disclosed. FIG. 3 illustrates a flow chart of a method **300** for transferring network data, according to an embodiment of the present invention. Now the detailed steps of the method **300** are described below with reference to FIG. 2 and FIG. 3. At step **301**, general computation is executed to generate general computing data by a GPU **208** of the graphics card **200b**. At step **302**, a pointer to the general computing data is bound to a texture to generate texture data by the GPU **208**. The general computing data and the texture are stored in a device memory **207** of the graphics card **200b**. At step **303**, the texture data is encoded to generate a data signal in a TMDS signal by a digital video sender **209** of the graphics card **200b**. At step **304**, the TMDS signal is output to a device **200a** for transferring network data via a DVI **210** of the graphics card **200b** by the digital video sender **209**. At step **305**, the data signal is converted to network data for being transferred via a network by a data processing module **201** of the device **200a**. At step **306**, the network data is received and transferred to an external device via the network by a network transmitter **202** of the device **200a**.

The graphics card and the device involved in the above method for transferring network data have been described in the description about embodiments of the system for transferring network data. For brevity, a detailed description thereof is omitted. Those skilled in the art can understand that specific structure and operation mode thereof with reference to FIG. 1, FIG. 2 and FIG. 3 in combination with the above description.

The foregoing description, for purpose of explanation, has been described with reference to specific embodiments. However, the illustrative discussions above are not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as may be suited to the particular use contemplated.

Embodiments according to the invention are thus described. While the present disclosure has been described in particular embodiments, it should be appreciated that the invention should not be construed as limited by such embodiments, but rather construed according to the below claims.

The invention claimed is:

1. A device for transferring network data, the device comprising:

a data processing module configured to convert a data signal in a transition minimized differential signaling (TMDS) signal to network data; and  
a network transmitter for transferring the network data to an external device via the network,  
wherein the data signal is generated by encoding texture data generated by a graphics processing unit.

2. The device according to claim 1, wherein a network data transfer operation of the device is controlled by a control signal in the TMDS signal.

3. The device according to claim 1, wherein the device is powered at least partially by a power signal in the TMDS signal.

4. The device according to claim 3, further comprising a power interface, via which an external power source provides additional electric energy to the device.

5. The device according to claim 1, wherein the data processing module includes:

a digital video receiver configured to decode the data signal to parallel data; and

a data converter configured to convert the parallel data to the network data according to a communications protocol.

6. The device according to claim 1, wherein the network transmitter is a wired network transmitter for transferring the network data to the external device via a wired connection.

7. The device according to claim 1, wherein the network transmitter is a wireless network transmitter for transferring the network data to the external device wirelessly.

8. The device according to claim 1, wherein the network transmitter includes a wired network transmitter and a wireless network transmitter, and the data processing module is further configured to control the network data to be transferred to the external device via the wired network transmitter or the wireless network transmitter.

9. The device according to claim 1, wherein the data processing module includes an encryption module configured to encrypt the network data before the network data is received by the network transmitter.

10. The device according to claim 1, wherein the data processing module includes an extended display identification data memory for storing virtual display information, so that a graphics card reads the virtual display information via the digital video interface and determines a transfer parameter of the TMDS signal according to the virtual display information.

11. The device according to claim 1, wherein the texture data is generated by binding a pointer to general computing data stored in a device memory of a graphics card to a texture stored in the device memory by the graphics processing unit.

12. The device according to claim 11, wherein the general computing data is generated by general computation executed by the graphics processing unit.

13. A system for transferring network data, the system comprising:

one or more subsystems for transferring network data, each of which includes a graphics card and a device for transferring network data,

wherein the graphics card includes:

a graphics processing unit configured to generate general computing data; and

a digital video sender for encoding texture data to generate a data signal in a transition minimized differential signaling (TMDS) signal and outputting the TMDS signal to the device; and

wherein the device includes:

a data processing module configured to convert the data signal to network data for being transferred via a network; and

a network transmitter for transferring the network data to an external device via the network.

14. The system according to claim 13, wherein the TMDS signal includes a control signal to control a network data transfer operation of the device.

15. The system according to claim 13, wherein the TMDS signal includes a power signal, which is transferred to the device via a digital video interface for powering the device at least partially.

16. The system according to claim 15, wherein the device further includes a power interface, via which an external power source provides additional electric energy to the device.

17. The system according to claim 13, wherein the data processing module includes:

a digital video receiver configured to decode the data signal to parallel data; and

a data converter configured to convert the parallel data to the network data according to a communications protocol.

18. The system according to claim 13, wherein the network transmitter is a wired network transmitter for transferring the network data to the external device via a wired connection.

19. The system according to claim 13, wherein the network transmitter is a wireless network transmitter for transferring the network data to the external device wirelessly.

20. The system according to claim 13, wherein the network transmitter includes a wired network transmitter and a wireless network transmitter, and the data processing module is further configured to control the network data to be transferred to the external device via the wired network transmitter or the wireless network transmitter.

21. The system according to claim 13, wherein the data signal includes a vertical synchronizing signal to control processing speed of the graphics processing unit.

22. The system according to claim 13, wherein the graphics processing unit is further configured to bind a pointer to the general computing data to a texture to generate texture data.

23. The system according to claim 11, further comprising a device memory for storing the general computing data and a texture for generating the texture data.

24. A method for transferring network data, the method comprising:

executing general computation to generate general computing data;

binding a pointer to the general computing data to a texture to generate texture data;

converting a data signal that is based on the texture data to network data for being transferred to an external device; and

transferring the network data to the external device via the network.

25. The method according to claim 24, further comprising encoding the texture data to generate the data signal in a transition minimized differential signaling (TMDS) signal.